

Title: Perimeter All Around

Brief Overview:

This is a performance-based learning unit that integrates problem solving and the study of perimeter. Students will demonstrate and use their understanding of perimeter in a variety of ways. Students will work cooperatively to design an arrangement for the school cafeteria using perimeter to help determine the available seating. This is a developmental lesson on perimeter, not an introductory lesson; therefore, students should have prior knowledge of perimeter.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
Students will demonstrate their ability to solve problems in mathematics including problems with open-ended answers and problems which are solved in a cooperative atmosphere.
- **Mathematics as Communication**
Students will demonstrate their ability to communicate mathematically. They will read, write, and discuss mathematics with the language and signs, symbols, and terms of the discipline.
- **Mathematics as Reasoning**
Students will demonstrate their ability to reason mathematically. They will make conjectures, gather evidence, and build arguments.
- **Mathematical Connections**
Students will demonstrate their ability to connect mathematics topics within the discipline and with other disciplines.
- **Estimation**
Students will demonstrate their ability to apply estimation strategies in measurement and in problem solving.
- **Number Sense and Numeration**
Students will demonstrate their ability to describe and apply number relationships using concrete and abstract materials. They will choose appropriate operations within problem solving situations.
- **Whole Number Computation**
Students will demonstrate their ability to apply appropriate computation skills within problem-solving situations.

- **Geometry and Spatial Sense**

Students will demonstrate their ability to apply geometric relationships using two- and three-dimensional objects. They will find area and perimeter. They will use geometric applications in real world problem-solving situations.

- **Measurement**

Students will demonstrate and apply concepts of measurement using non-standard, standard units, metric, and customary units. They will estimate and verify measurements. They will apply measurements to real-world problem-solving situations.

- **Patterns and Relationships**

Students will demonstrate their ability to recognize geometric patterns.

Grade/Level:

Grade 5

Duration/Length:

This unit takes approximately 4 class periods (45 to 60 minutes) for development and 1 to 2 class periods for the assessment. Depending upon ability levels of students this time may need to be extended.

Prerequisite Knowledge:

Students should have a basic working knowledge of the following skills:

- Using measuring tools
- Using geoboards, pentominoes, and grid paper
- Beginning understanding of perimeter and area

Objectives:

Students will:

- define perimeter.
- work cooperatively with others.
- demonstrate the ability to solve problems related to perimeter.
- solve problems using a variety of strategies.
- distinguish between area and perimeter.
- determine the relationship between area and perimeter.
- defend a position.
- design a floor plan incorporating the concept of perimeter.

Materials/Resources:

- Measuring tools-meter sticks, yard sticks, rulers, paper clips, and others determined by teacher
- Geoboards and geobands
- Pentominoes
- Grid paper (included)
- Pencils and paper
- Coloring utensils
- Student resource sheets (included)
- Scissors
- Tape

Development/Procedures:

Day 1:

- Distribute geoboards and geobands. Review the concept of area (1 square is equivalent to 1 square unit of area).
- Distribute **Student Resource 1**.
- As a class complete problem 1. Discuss possible perimeters. Be sure students understand how to find the perimeter by counting the length between two vertical or two horizontal pegs as 1 unit.
- Continue as a class with problems 2 and 3 as needed. Use only rectangles. Point out the different ways to make these rectangles.
- Have students work in groups of 3 or 4 to complete **Student Resource 1**.
- After the groups have completed their work, share and discuss results.
- Have students write about what they have learned and discovered using words, numbers, and/or pictures.

Day 2:

- Review the concept of perimeter.
- Distribute **Student Resource 2**.
- Read directions together. Explain that some of the problems require specific criteria (problems 1-12) and other problems leave all criteria to be decided.
- Show students the measuring tools available and encourage other non-standard measuring tools.
- As a class do problem 1.
- Have groups complete **Student Resource 2**.
- After the groups have completed their work, share and discuss results.
- Have students write about what they have learned and discovered using words, numbers, and/or pictures. Students should include the most unusual non-standard tool for measurement.

Day 3:

- Review: By adding the lengths of all the sides of a polygon, the perimeter is determined.
- Distribute pentominoes and 1-inch grid paper.
- Allow students to explore with the pentominoes.
- Have students combine three pentominoes to create different shapes.
- Challenge students to find a three-pentomino shape with the smallest perimeter. Then challenge the students to find a three-pentomino shape with the largest perimeter.
- After 10 minutes of exploration, bring the groups together to discuss their findings. The teacher should not reveal solutions. Encourage students to continue to search for better solutions until they are satisfied with their results.
- Have students share any new findings. (An overhead projector would be useful for class sharing.)
- Have students write about what they have learned and discovered using words, numbers, and/or pictures. Students should include the method used to find the shortest perimeter.

Day 4:

- Review the concept of perimeter and the insights gained from the previous lesson.
- Distribute pentominoes and 1-inch grid paper.
- Explain to students that tables come in a variety of shapes to meet different needs. Brainstorm different styles of tables and their functions. (Teachers may want to make a visual for students.) Lead students into discussion of pentominoes as table configurations.
- In groups of 4 examine each pentomino and discuss which ones would make good tables to use in the lunch room. Using the 1-inch grid paper, students will be able to see the seating space for an individual. (1 unit length is equivalent to the seating space for 1 person. Not all lengths will be functional due to adjacent lengths.) Encourage students to look at shape, comfort, ability to carry on a conversation (noise level), effective use of table space or area, and the number of people able to use this table at one time.
- After students have discussed in groups, share ideas as a class. (An overhead projector, chalkboard, or chart with the shapes would be useful in this discussion.)
- As a class choose the 5 best table configurations. Be sure to discuss the positive aspects of these tables. During the discussion also emphasize the most undesirable table configurations.
- Have students write about this experience and rank the 5 best choices. Explain that in the next activity the top three choices will be used.

Performance Assessment:

Day 5:

- **Prior to the final lesson:** Determine the dimensions of the school cafeteria to the nearest foot. Each group will need grid paper based upon the size of the room. Grid paper in various sizes has been provided including 1-inch, $\frac{1}{2}$ -inch, and $\frac{1}{4}$ -inch. This lesson is based upon using the $\frac{1}{4}$ -inch grid paper. The number of sheets per group is determined by the size of the cafeteria. The lesson is based upon 120 people using the cafeteria. The 120 was chosen since it has many multiples and offers a variety of solutions. If this number is not appropriate in your situation, adjust as needed.
- Have students refer to their writing from Day 4 and recall their three top choices for table configurations. Explain that in today's activity they will be applying their knowledge of perimeter and their choice of table configurations from the previous day.
- Distribute the $\frac{1}{4}$ -inch grid paper. Each group will need 5 sheets (4 for the floor plan and 1 for the table configurations). Trim edges and attach the grids with tape so that the rows and columns are aligned. As a class, draw the perimeter of the cafeteria on the grid. Excess grid can be removed. Draw on the grid any doorways and other special features of the cafeteria that would affect the placement of tables.
- Demonstrate for students how to recreate the pentominoes on the $\frac{1}{4}$ -inch grid paper using scale. Allow time for students to recreate their top choices.
- Distribute **Student Resource 3**. Read the directions together and answer questions.
- Allow groups of 4 to work on the problem. Adjust time accordingly.
- When students have completed the activity, collect, and assess final products.
- After the teacher has reviewed all projects, have students share floor plans with the class.
- Allow students to write what they have learned from this unit.

Extension/Follow Up:

- Day 3 can be extended by having students construct a 6 by 10 rectangle using all 12 pentominoes.
- Day 5 activity can be extended by having students measure the needed dimensions for the activity. The lesson has this task assigned to the teacher.
- Students could write a persuasive paragraph to the cafeteria manager regarding their floor plans and recommendations for table styles.
- Working in cooperative groups, students can create speeches promoting their recommendations.

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Student Resource 1

- For each area given find the possible perimeters and record your answers in the grid below. There may be only one possible answer or there may be more.

Area of Rectangle	Possible Perimeter Outcomes							
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								

Student Resource 2

Use objects around the room to complete each of the items below. Items **1 - 4** give the unit of measure to be used. You select the object to measure. Items **5 - 8** give actual perimeter. You must find objects in the room that match those perimeters. Items **9 - 12** name the object to be measured. You may use standard or non-standard measurements for these. Complete items **13 - 15** using any remaining objects in the room and any appropriate unit of measurement.

Object	Unit of Measure-ment	Estimation of Perimeter	Actual Measure of Perimeter	Is your unit standard or non-standard?
1.	Inches			
2.	Centimeters			
3.	Paper clips			
4.	Shoe			
5.			10	
6.			40	
7.			100	
8.			200	
9. door				
10. your desk				
11. chalkboard				
12. chalkboard eraser				
13.				
14.				
15.				

Student Resource 3

Your class has been asked to redesign the floor plan and table shapes in the school cafeteria. The carpentry class will build the tables, but they are limited to 3 designs and a total of 20 tables. Your group must choose the 3 table designs and their placement. Use your grid paper to record your work.

Your floor plan must:

- include at least a 1-foot walking space between non-adjacent tables
- include at least a 1-foot walking space between the walls and tables
- include at least a 5-foot walking space in front of the doorways and exits

As you are working, also think about:

- the purpose of the tables
- the space needed for eating and conversing with your friends
- the number of tables needed
- the number of seats per table
- the need for space around and away from the tables and parts of the cafeteria that can not be changed.

(Hint) By combining tables the seating may be increased and area is conserved. Apply your perimeter knowledge to effectively use the space.

When your group has finished, write a summary that describes your floor plan and explains why it is the most logical design. Explain how you used perimeter in your plan.

You will be evaluated on your floor plan and your summary. Use specific details in your writing to give the reader a vivid and clear description. Review your work to revise and edit. Remember do your best!

Scoring Tools

Analytic Format for Floor Plan

	Placement of tables, walking spaces, doors, walls	Pleasing to the eye (attractive)	Perimeter of tables will accommodate number of students (120)	Floor Plan labels--title, symbols, key
3	completely accurate	extremely	completely accurate	has title, symbols, complete key with symbols explained
2	partially accurate	somewhat	partially accurate	has title, some symbols, partial key with symbols explained
1	inaccurate	little shown or no evidence	generally inaccurate	no title, few/no symbols used or explained in key
0	blank, off-task, illegible	blank	blank, off-task, illegible	no evidence

Analytic Format for Writing to Inform

	Addresses audience's needs	Organization of ideas	Explanation for logical design
3	consistently addresses with complete summary of floor plan with many specific details that give a vivid description	accurate organization	3 or more reasons given to support design
2	sometimes addresses with partial summary of floor plan with some specific details that give a vivid description	somewhat accurate organization	2 reasons given to support design
1	rarely addresses by giving limited summary of floor plan with little/few details yielding vague description	inaccurate organization	1 reason given to support design
0	no response/no summary	no organization/completely off-task	no explanation given

Pentominoes









